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ABSTRACT

This document reports data from a study designed to identify student behaviors related to academic success and involving 303 students enrolled in natural science classes at Kansas State University. Results of student responses to the Inventory of Study Practices are presented and implications for students, advisors, and teachers are identified. (HM)

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STUDENT BEHAVIORS RELATED TO ACADEMIC SUCCESS OF UNDERGRADUATES AT KANSAS STATE UNIVERSITY IN THE NATURAL SCIENCES

by Jerald W. Dallam

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INTRODUCTION

It is generally agreed that learning is a function of both the situation and the organism (learner) (Gagne: 1965). Also, educators have long observed that providing good instruction, a rich and stimulating environment, and well-written, information materials does not guarantee that learning will occur. Some sort of active "learner involvement" is required. This investigation was designed to ascertain what types of learner behaviors are particularly condusive to learning. Specifically, this study examined the student's role in the learning process.

It was hypothesized that students behaviors that enhance academic success in the Natural Sciences were contingent on three variables: (1) type of learning (the study was limited to courses which normally stress low-level cognitive growth), (2) teaching method (lecture, discussion/recitation, self-paced) and (3) student academic ability.

A few studies have addressed the problem of identifying student behaviors related to academic success. Although some of these studies were relatively sophisticated experimental investigations, many provided little or no control; some were scarcely more than simple surveys. Many have utilized Robinson's Effective Study (1961) as a model of good study skills. The Brown-Holtzman Survey of Study Habits and Attitudes (SSHA) has been the most popular instrument to assess study behavior.

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The literature suggested some directions for this present study, but offered no firm, well-established generalizations on the relationship of student behavior to academic accomplishment. Tentative conclusions from the literature which seem relevant to the construction of an instrument for this investigation include the following: (1) It should assess academic drive, expectations, and effort. (2) It should include student behaviors which authorities regard as "low" in effectiveness. (3) It should assess the influence of roommates, willingness to cooperate, and acceptance of responsibility. (4) It should determine whetner or not students have established study patterns which proved enjoyment and satisfaction or create aversive reactions. (5) It should review background information related to finances, health, and parental or social influences on academic plans.

PROCEDURE

The Instrument:

Only a few instruments relative to the problem have been published. For a variety of reasons, none was regarded as adequate for the present investigation. Therefore, a new device was constructed.

Items were written to reflect the findings of the literature, and a few were taken from an experimental instrument developed by Pace (1973). The major source of items, however, was a survey of current students. During the fall semester 1976, eight different instructors representing three broad academic fields (natural sciences, social sciences and humanities) and three different teaching methods (lecture, discussion and self-paced) permitted the investigator to ask their students two open-ended questions:

(1) Describe one or two specific things that you have done (in or out of class), that have proved really valuable in helping you succeed in this course.

(2) Have you tried some approaches to study for this course (either in class or out of class) which later proved to be ineffective for you? If so, please list such activities.

A total of 317 students voluntarily responded. After an initial screening for redundancy there were 163 behavioral statements that appeared to be germane. These items were sorted into 49 groups of homogeneous content. A single item was then selected (or composed) to represent each group. This preliminary

Inventory of Study Practices consisted of three parts: Part I attempted to assess how characteristic each of 32 practices were of the students' effort in this course; Part II focused on six general study practices, and not just those for the course in question; and Part III assessed other general factors suggested by the review of the literature (health, career goals, etc.). Students were asked to respond on a five-point scale (1=not at all true of me; 5=very true of me).

The preliminary instrument was administered to 266 students in six additional classes: three lecture and three small-discussion classes. Self-Paced classes were not included because most of these students had already completed the semester's work.

The purpose of this administration was to gain some statistical information about the Inventory which could help conceptualize its content, establish its reliability, and provided a basis for further revision.

Mean scores were calculated for each of the 49 items. Two questions produced very high means (#20, "In class, sit in a location where you can see and hear satisfactorily", and #47 "A college degree is very important to me") and thus did not discriminate effectively among the respondents. Therefore, it was decided to delete Question 20 and revise Question 47 to read "A college degree is one of my three most important goals." One additional question was added to ascertain how students perceived the teaching method used in the class. These changes resulted in the final version of the research instrument.

Sample

The problem required that effects of student behavior on achievement be determined after extraneous effects due to method of instruction and student ability had been taken into account. In essence, these requirements suggested the desirability of studying students classified by three teaching methods (lecture, discussion, self-paced). To exclude possible effects due to course level, it was decided to limit the study to lower division courses (i.e., those in which most enrollees were freshmen and sophomores).

Instructors in six different natural science courses were asked to cooperate in this research. Each had successfully taught the same course using the same method on at least one previous occasion. They were informed that participation would require approximately 30-45 minutes of their class time during the twelfth and thirteenth week of spring semester for the purpose of administering the Inventory of Study Practices. Instructors were also advised that it would be necessary to provide a numerical score to represent the student's final grade. All of the instructors agreed to participate.

Although the principles of random sampling could not feasibly be employed, it was assumed that students participating in the study were representative of those at KSU who enroll in lower division science courses. Therefore, findings were expected to generalize to such students on the condition that the instructor had prviously had a successful teaching experience in that setting.

Although the total sample consisted of 852 students enrolled in lower division courses, this study focused only on the 303 who were in science courses. These students were volunteers who signed a 'Consent Form' indicating their willingness to participate in the Study. Also, all these students completed the course and had previously accumulated a minimum of ten semester hours at KSU. Cumulative G.P.A. was used to assess academic ability, a variable whose influence on grades has been well established, (Lavin, 1965).

DESIGN

A three-process design was selected. The first was to conceptualize the student behaviors assessed by the Inventory. A second process was devised to determine the relevance of individual behaviors or dimensions of behavior. Finally, a process was instituted to consider the simultaneous effects of many (or all) behaviors.

PROCESS 1: CONCEPTUALIZATION

In order to conceptualize and measure the variables represented by the behavioral items, Inventory responses of the 266 students who responded in the fall semester of 1976 were subjected to principal component (factor) analysis. Thirteen factors with eigenvalues of 1.00 or more were extracted; they accounted for 57.1% of the variance. Items with rotated factor loadings of .3 or higher on a given factor were combined to form a "factor scale". If a given item loaded on more than one factor, it was included only on the factor where its loading was highest.

Coefficient alpha was calculated for each of the thirteen scales in order to estimate the internal consistency reliability. Table 1 names the factors, provides sample items, and shows the reliability of each scale. Scales for assessing "Listening vs. Reading" (Factor VIII) and "Over-Commitment" (Factor X) had such low coefficients (.31 and .38) that they were excluded from further analysis.

TABLE 1

FACTORS, SAMPLE ITEMS, AND SCALE RELIABILITY

Factor	Representative Items	Coef. Alpha
I. Student Initiative	9. After class, ask the instructor about material which is unclear to you. 29. Voluntarily do some unassigned readings related to the course.	.71
II. Self-Discipline	41. I lack self discipline. 37. During the day, use the time between classes to study.	.62
III. Outside Distractions	45. I have been distracted this semester by some personal problem (roommate, parents, love, etc.) 42. Financial problems interfere with my ability to do as well as I could in my classes.	.59
IV. Cooperative Study	21. Study with a friend. 20. Prepare for examinations by participating in question-answer sessions with one or more friends in the course.	.69
V. Transfer of Learning	8. Engage other people (adults, friends, other class members) in discussion about concepts or ideas discussed in this class. 25. Explain course concepts, ideas, techniques, etc. to someone else (classmates, roommate, parents).	.71
VI. Emphasis "Rote"	6. Just prior to examinations, memorize important lists, dates, names, definitions, etc. 7. "Cram" hard the night before an examination.	.69
VII. Spotting Highlights	13. Underline important points in the assigned readings. 14. Underline the important points in class notes.	.76
VIII. Listening vs. Reading	1. Listen carefully to instructor presentations, even if this results in poor note taking. 16. Review by re-reading the summaries of each chapter.	.31
IX. Reading Skills	44. I have difficulty in concentrating on reading assignments. 47. I have the ability to read rapidly.	.52
X. Overcommitment	38. I am over-committed on outside activities (intramurals, dates, extracurricular participation, etc.) 34. Do most of your studying after 10 P. M.	.38
XI. Reducing Ambiguity	31. Do not just ignore ideas or concepts which are unclear; either persist until you understand or seek assistance. 30. Pay close attention to diagrams, drawings, tables and similar material used to illustrate or summarize points.	.68
XII. Goal Orientation	46. A college degree is one of my three most important goals. 39. I have clear goals in mind which are related to the educational program I am following.	.62
XIII. Conscientiousness	4. Make certain that assignments are completed by the deadline. 17. Avoid getting more than one day behind in the assigned reading.	.66

PROCESS 2

The purpose of the second set of analyses was to discover whether any of the factor scores or individual items were related to achievement (end of course grades) and whether the answer to this question depended on teaching method or student ability, Students were classified by class achievement (upper half=high; lower half=low), teaching method (lecture, recitation, or self-paced), and previous G.P.A. at KSU (high, average, low). Three way analyses of variances were performed on each factor score. Our interest was in the main effect for achievement and in the achievement x method and achievement x ability interactions.

A significant main effect was found on seven of the factor scores; these are illustrated in Table 2.

TABLE 2

FACTORS DIFFERENTIATING HIGH AND LOW ACHIEVERS IN THE NATURAL SCIENCES

Factor	Achievement		Sig. Level
	Low	High	
I. Student Initiative	11.67	12.76	05
II. Self Discipline	12.29	13.75	01
III. Outside Distractions	10.28	8.58	01
IV. Cooperative Study	8. 11	6. 47	01
IX. Reading Skills	16.51	17.45	05
X. Goal Orientation	7.29	7.91	05
XI. Conscientiousness	12.73	13.53	05

The high achieving group obtained a significantly higher mean score than the low achieving group on Student Initiative, Self-

Discipline, Reducing Ambiguity, Goal Orientation, and Conscientiousness. On two factors (Outside Distractions, Cooperative Study), the High Achievers had significantly lower scores. By interpreting these findings literally, we can conclude that students who succeeded in their science studies were likely to exhibit initiative, self-discipline, and conscientiousness; they also sought to clarify uncerainties, to reduce outside distractions, and to avoid cooperative study; more than their low achieving counterparts, they were goal oriented.

Only one interaction of each type was significant. The role of Student Initiative in academic success appears to be much less important in science courses taught by lecture than in those tuaght by recitation or self-paced methods. Table 3 supplies the results from which this conclusion was drawn.

TABLE 3

INTERACTION BETWEEN ACHIEVEMENT AND METHOD ON "STUDENT INITIATIVE"

Factor	Method	Achievement		Sig. Level
I. Student Initiative	Lecture	Low	11.08	
		High	11.21	
	Recitation	Low	11.58	.05
		High	13.84	
	Self-Paced	Low	11.99	
		High	14.06	

Similarly, Self-Discipline appears to be most relevant for those who have the best cumulative G.P.A.'s. See Table 4.

TABLE 4

INTERACTION BETWEEN ACHIEVEMENT AND ABILITY (PREVIOUS G.P.A.) ONE "SELF-DISCIPLINE"

Factor	Method	Achievement		Sig. Level
II. Self-Discipline	Low Ability	Low	12.41	
		High	13.05	
	Average Ability	Low	12.85	.05
		High	13.28	
	High Ability	Low	12.09	
		High	14.85	

Analyses identical to those just described were also performed for each item on the instrument. Significant differences were found between high and low achieving science students on the 16 items shown in Table 5.

TABLE 5

DIFFERENTIATING HIGH AND LOW ACHIEVERS IN SCIENCE COURSES

	Achievement Group Mean		
	Low	High	Sig. Level
7. Cram hard the night before a test.	3.75	3.25	.01
9. After class, ask instructor about unclear material.	1.98	2.45	.01
14. Underline class notes.	3.67	3.30	.05
16. Review by re-reading summaries of each chapter.	3.57	3.18	.05
21. Study with a friend.	2.71	2.22	.01
27. Attend every class unless prevented by illness or injury.	3.61	4.10	.01
30. Pay close attention to drawings, tables, etc.	3.58	3.89	.05
31. Don't ignore unclear ideas and concepts.	3.30	3.77	.01
32. Find a good place to study and stick to it.	3.85	4.25	.01
33. Avoid distractions in study places.	3.57	3.92	.05

TABLE 5 (Cont.)

DIFFERENTIATING HIGH AND LOW ACHIEVERS IN SCIENCE COURSES

	Achievement Group Mean		
	Low	High	Sig. Level
37. Use time between classes to study.	2.59	3.26	.01
38. Over-committed to outside activities.	3.05	2.50	.01
39. Clear goals selected to educational program.	3.27	3.76	.01
42. Financial problems interfere.	2.48	1.97	.01
43. Health problems interfere.	2.10	1.60	.01
45. Distracted by personal problem	3.02	2.59	.05

Several of these items suggest that successful science students avoided distraction from their studies and their academic goals (Items 33, 38, 39, 42, 43, 45). They appeared to pursue questions thoroughly in the interest of clarification (Items 9, 30, 31). They were unlikely to follow "gimmicks" commonly recommended to enhance that performance (Items 7, 14, 16), but instead conscientiously and independently pursued learning (Items 21, 27, 32, 37).

In addition to these main effects, a number of significant interactions were found. Two of these were between achievement and method. See Table 6.

TABLE 6

ITEMS DISPLAYING A SIGNIFICANT INTERACTION BETWEEN ACHIEVEMENT AND METHOD

Item	Item Means						Sig. Level
	Lecture		Recitation		Self-Paced		
	Low	High	Low	High	Low	High	
9. After class, ask instructor about unclear material.*	1.82	1.93	1.89	2.65	2.16	2.53	.05
10. Make it a point to engage instructor in out-of-class discussion of interesting points.	1.52	1.39	1.67	1.84	1.61	2.00	.05

*Achievement main effect was also significant.

Asking the instructor to clarify ambiguities proved to be very effective in recitation classes, moderately effective in self-paced, of little or no value in lecture classes. Similarly, engaging the instructor in a discussion of interesting points after class was strongly related to achievement in self-paced and moderately related in recitation; but in lecture classes, low achievers were more likely than high achievers to follow this tactic.

Significant ability/achievement interactions were plentiful, as noted in Table 7.

TABLE 7

ITEMS DISPLAYING A SIGNIFICANT INTERACTION BETWEEN ACHIEVEMENT AND ABILITY (GPA)

Item (Achievement)	Item Means: Lo. Abil. Low	Lo. Abil. High	Avg. Abil. Low	Avg. Abil. High	Hi. Abil. Low	Hi. Abil. High	Sig. Level
13. Underline important points in assigned readings.	3.81	3.25	3.68	3.78	3.53	3.90	.05
22. Spend a few minutes reviewing just before class begins.	3.08	2.36	2.64	2.83	2.66	2.71	.02
23. Take notes on assigned outside readings.	2.51	2.07	2.05	2.30	1.57	2.52	.02
28. Resist temptation to post-pone difficult, dull, or lengthy assignments.	3.00	2.70	2.88	3.08	2.60	3.38	.05
32. Find a good study spot and stick with it.*	3.95	4.28	4.15	4.04	3.49	4.34	.01
37. Use time between classes to study.*	2.68	3.14	2.95	3.14	2.57	3.67	.05
39. Clear goals related to educational program.	3.42	3.37	3.59	3.76	3.01	4.19	.01
45. I have been distracted by some personal problems.	3.32	2.37	3.08	2.73	2.26	2.66	.01

*Achievement main effect was also significant.

A similar pattern was found for Items 13, 22, 23, 28, and 39. Among low ability science students, low achievers were more likely than high achievers to pursue behaviors depicted by these items; but for "average" and "high" ability students, the opposite finding was obtained. In brief, low ability students had more success with science courses when they underlined

important points, reviewed just before class, took notes on assigned readings, and postponed difficult assignments; but for average and high ability students, these behaviors were related to low achievement. High achievers were more likely than low achievers to stick to a good study spot (Item 32) and use time between classes to study (Item 37), but the differentiation was much sharper for high ability students than for the other two groups.

PROCESS 3: THE COMBINED EFFECTS OF STUDENT BEHAVIORS

In Process 3 analyses, we examined the combined effects of student behaviors on achievement. Multiple regression was used to take into account the independent contribution of each scale (or item) to the prediction of academic success. Because we were especially interested in accounting for variance which could not be explained by ability (as measured by previous G.P.A.), cumulative G.P.A. at KSU was also used as a predictor.

Results are reported in Table 8.

TABLE 8

FACTORS SELECTED IN MULTIPLE REGRESSION ANALYSIS FOR SCIENCE COURSES TAUGHT BY LECTURE, RECITATION, AND SELF-PACED METHODS

	NS-Lec		NS-Rec		NS-SP	
	r	B	r	B	r	B
I. Student Initiative			.33	.59		
II. Self Discipline						
III. Outside Distractions	-.27	-.60	-.43	-1.02		
IV. Cooperative Study			-.09	-.57		
V. Transfer of Learning						
VI. Emphasis Rote					-.20	-.93

TABLE 8 (Cont.)

FACTORS SELECTED IN MULTIPLE REGRESSION ANALYSES FOR SCIENCE COURSES TAUGHT BY LECTURE, RECITATION, AND SELF-PACED METHODS

	NS-Lec		NS-Rec		NS-SP	
	r	B	r	B	r	B
VII. Spotting Highlights						
VIII. Reading Skills			-.04	-1.31		
IX. Reduce Ambiguity						
X. Goal Orientation					.24	.80
XI. Conscientiousness						
G.P.A.	.63	8.24	.43	6.38	.58	9.31
R		.66		.64		.63

Using the 11 factor scores and previous G.P.A., multiple correlations ranging from .63 to .66 were obtained for three natural science groups.

The pattern of predictors varied among the three gorups. For classes taught by the lecture method, previous G.P.A. correlated .63 with science grades. Factor scores could improve this correlation by only .03, due entirely to the negative relationship between achievement and "Outside Distractions". For self-paced courses, previous G.P.A. correlated slightly lower with science achievement (r=.58); by adding factor scores, this was improved to .63. Contributing to this improvement were scores on two factors: Goal Orientation (positive) and Emphasis on Rote (negative).

Results for Recitation classes contrasted sharply with those for the other two methods. Previous G.P.A. correlated only .43 with science achievement in these classes; but when factor scores were added, the multiple correlation increased

to .64. This marked improvement was due largely to the substantial independent contributions made by two scales--Student Initiative (positive) and Outside Distractions (negative). Less substantial, but significant, contributions were also made by Cooperative Study (negative) and Reading Skills (negative).

On the basis of these findings, it appears that the student's contribution to his/her achievement in science is substantially greater in recitation courses than in any other type. Under the lecture method, variations in approaches to study were of little significance.

Additional analyses were undertaken to predict science achievement in each of the three teaching method groups by combining results on individual items. Findings from Process 2 were used to select items for inclusion in the regression analyses. (see tables 5-7) In these analyses, we performed step-wise multiple regressions first with G.P.A. included as a predictor and then excluding G.P.A. The latter analyses were performed to obtain an estimat of the amount of variance in science achievement which could be accounted for purely by differences instudent approaches to study.

Table 9 displays significant items selected for the Natural Science Lecture group. As noted earlier, previous G.P.A. correlated .63 with classroom grades in science. By optimally combining items from the "student inventory", this correlation was improved to .70. Students in lecture classes who conscientiously worked through study guides and who avoided financial problems were more successful than those with the

opposite tendencies. Given these behaviors, then getting behind in assignments was also more characteristic of high achievers. The latter finding, may reflect the high importance of study guides in this learning situation; a thorough mastery of limited material may be more valuable than a superficial coverage of all the material.

If one concentrated purely on student behaviors related to achievement and ignored previous G.P.A. as a predictor, then four items yielded a multiple correlation of .47. Two of these were mentioned earlier (working through study guides; avoiding financial problems). A third stresses clearing up ambigious ideas and concepts. The fourth, voluntarily doing outside readings, was a negative predictor in this case. Again in this instance, the effort expected may be so great that outside, voluntary reading may be more indicative of avoidance of assignments than of commitment to the subject.

TABLE 9

ITEMS SELECTED IN MULTIPLE REGRESSION ANALYSIS FOR THE NATURAL SCIENCE LECTURE GROUP

Item	w/G.P.A.		w/o G.P.A.	
	r	B	r	B
1. Listen carefully to instructor's presentation, even if it results in poor note-taking.	-	-	-	-
2. Discover instructor's biases.	-	-	-	-
3. Conscientiously work through study guides, etc.	.24	1.77	.24	2.25
17. Avoid getting behind.	-.16	-1.58	-	-
29. Voluntarily do unassigned reading.	-	-	-.14	-2.65
31. Don't ignore unclear ideas or concepts.	-	-	.25	2.72

TABLE 9 (Cont.)

ITEMS SELECTED IN MULTIPLE REGRESSION ANALYSIS
FOR THE NATURAL SCIENCE LECTURE GROUP

Item	w/G.P.A. r	w/G.P.A. B	w/G.P.A. r	w/G.P.A. B
38. Over-Committed, outside activities.	-	-	-	-
42. Financial problems interfere.	-.25	-1.09	-.25	-1.42
G.P.A.	.63	7.90		
R	.70		.47	

Table 10 summarizes results for the Natural Science Recitation group. As suggested by earlier findings, responses to the inventory, when combined optimally, were more predictive of achievement than was previous G.P.A. In fact, the latter added only .05 to the multiple R obtained from behavior items alone.

Three items appeared in both analyses. Asking the instructor about unclear material (Item 9) appears vital (r=.47) in recitation classes. Likewise, achievement was facilitated by avoiding outside commitments and, to a minor degree, by avoiding health problems.

TABLE 10

ITEMS SELECTED IN MULTIPLE REGRESSION ANALYSIS
FOR THE NATURAL SCIENCE RECITAION GROUP

Item	Direct Scale w/G.P.A. r	w/G.P.A. B	w/o G.P.A. r	w/o G.P.A. B
4. Make certain assignments are completed by deadline.	-	-	-	-
9. After class, ask instructor about unclear material.	.47	2.96	.47	3.55

TABLE 10 (Cont.)

ITEMS SELECTED IN MULTIPLE REGRESSION ANALYSIS FOR THE NATURAL SCIENCE RECITATION GROUP

Item	Direct Scale			
	w/G.P.A.		w/G.P.A.	
	r	B	r	B
11. Take advantage of offers for special help.	-	-	-	-
13. Underline important points in assigned readings.	-	-	-	-
16. Review by re-reading summaries of each chapter.	-	-	-	-
38. Over-committed, outside activities.	-.38	-2.52	-.38	-2.91
41. I lack self-discipline.	-	-	-	-
42. Financial problems interfere.	-	-	-	-
43. Health problem interfere.	-.17	-1.26	-.17	-1.34
44. Difficulty concentrating on reading assignements.	-	-	-	-
45. Personal problems interfere.	-	-	-	-
G.P.A.	.43	.89		
R	.66		.61	

Findings for the Self-Paced Natural Science are reviewed in Table 11. Previous G.P.A. was easily the most potent predictor for this group (r=.58); by adding responses to two items, this correlation was increased to .65. Having a clear goal related to educational program was facilitative of achievement in this group; and cramming had a negative effect.

If G.P.A. is ignored, the most relevant items were having a clear goal (positive), studying with a friend (negative), and re-reading summaries (negative). The negative items suggest that, for Self-Paced Natural Science classes, mastery of details is essential. Summaries will be too superficial to help; the

opinions or personal interpretations of others will be irrelevant. By optionally combining responses to these three items, a very respectable multiple correlation of .47 was obtained.

TABLE 11

ITEMS SELECTED IN MULTIPLE REGRESSION ANALYSIS FOR THE NATURAL SCIENCE SELF-PACED GROUP

Item	Direct Scale			
	w/G.P.A.		w/o G.P.A.	
	r	B	r	B
7. Cram hard the night before exam.	-.24	-1.53	-	-
16. Review by re-reading summaries.	-	-	-.20	-1.36
20. Prepare for exam by participating in Question-Answer sessions.	-	-	-	-
21. Study with a friend.	-	-	-.33	-1.52
37. Use time between classes to study.	-	-	-	-
39. Clear goal related to educational programs.	.38	1.79	.38	2.67
G.P.A	.58	8.59		
R		.65		.47

CONCLUSIONS AND IMPLICATIONS

The following generalizations emerged from the investigation:

(1) In broad terms, student approaches to study were related to achievement as measured by classroom grades; not all items or all scales were significantly correlated with achievement, but the number of meaningful items and scales were considerably greater than chance.

(2) Beyond this, it was possible to combine items and scales so as to account for a larger proportion of criterion (achievement) variance than could be accounted for by single items or scales; that is, the various behavior measures were not totally redundant, even though a number of significant items or scales failed to make independent contributions to prediction.

(3) Finally, each combination of ability and teaching method resulted in the identification of a relatively unique pattern of relevant study behaviors. Although a few items appeared relevant in most situations, it was apparent that student behaviors which contribute to academic success in the sciences depended on both student ability (previous G.P.A.) and teaching method.

Implications can be drawn for students, advisors, teachers, theorists, and future research.

(1) Students should be aware of how academic ability helps determine appropriate study behavior, conditions under which reading ability is critical, and situations where outside distractions may be important. They should make appropriate and timely use of Financial Aid and Student Health Offices.

(2) Academic Advisors should attemtp to assess the student's previous G.P.A., maturity, reading ability, and financial/personal problems. They should be aware that the student's status on these matters is related to achievement under circumstances defined by field of study and method of instruction.

(3) Instructors should be encouraged to concentrate on clear and interesting lectures, should encourage students to ask questions, and should stress the

importance of keeping up to date on assignments.

(4) "Learning Theorists" need to take into account the fact that learning involves more than teacher activity and instructional materials; student behaviors play an important role. Student motivational status and their instrumental approaches to learning are both related to academic success. Theoretical systems need to account for complex interactions among student ability, teaching method, and student behaviors.

(5) Finally, future research should refine the instrument and improve assessment of student ability. A wider, larger, and more representative sample of students should be used. Considerably more attention and care should be given to conceptualizing and measuring the criterion (academic success). Eventually research should address the question: How can student behaviors be taught so that their opportunities for academic success are improved?

REFERENCES

Brown, Fredrick G. Study Habits and Attitudes, College Experience, and College Success, Personnel and Guidance Journal (1964) 287-291.

Gagne', Robert M. The Conditions of Learning. New York: Holt, Rinehart and Winston, Inc., 1970.

Hoyt, Donald P. Instructional Effectiveness Identifying Effective Classroom Procedures, Research Report, 7, (1969) 1-2.

_____. Instructional Effectiveness Measure of Effective Classroom Procedures, Research Report, 6, (1969) 1.

_____. College Student: Predictions of College Success, Encyclopedia of Education, (1963) 227-233.

Lavin, David E. The Prediction of Academic Performance. New York: Russell Sage Foundation, 1965.

Robinson, Francis. Effective Study. New York: Harper & Brothers, 1961.